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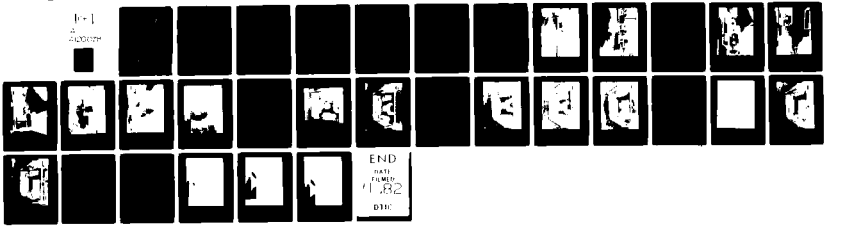

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Coast Terminal Radar Approach Control Facility (TRACON) Refurbishment

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August 1982

Final Report

U.S. Department of Transportation
Federal Aviation Administration
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16. Abstract

This study was conducted as a result of the Western Region's decision to change the Coast Terminal Radar Approach Control Facility (TRACON) layout from a horizontal radar island-type operation to a vertical radar perimeter-type operation. This change was brought about by a Federal Aviation Administration (FAA) decision to add terminal control advisory service to the Coast TRACON functions. In addition, the present lighting system used at the Coast TRACON produced undesirable reflections and glare.

Several equipment configurations were proposed by facility and Western Region office personnel as well as by the FAA Technical Center personnel. These proposals were evaluated by Coast TRACON and Western Region office personnel. The governing factors were available space, cost, and impact on facility operations. The preferred configuration, provided additional space by recessing one row of consoles within the wall which divides the TRACON operational and maintenance areas. Experiments with various lighting techniques produced more useable ambient light while it reduced glare and reflections.

Further, this study also disclosed the need to develop a new model of overhead enclosures (or shrouds) to accommodate planned instrumentation of the future.

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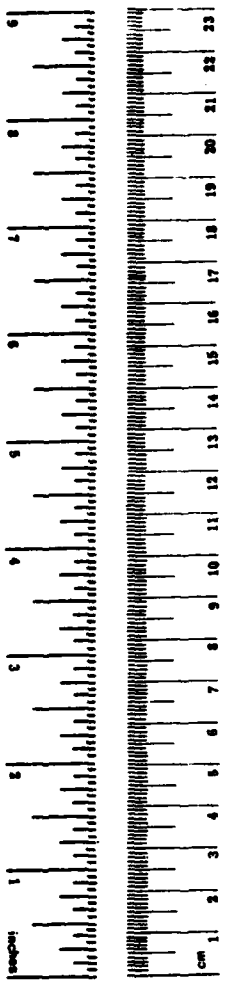
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

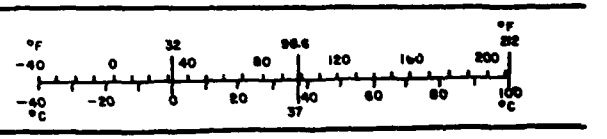
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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INTRODUCTION

PURPOSE.

The purpose of this study was to assist the Western Region in the selection of an appropriate design for the Coast Terminal Radar Approach Control Facility (TRACON) including improved room lighting conditions. (Figures 1a and 1b show two views of the present Coast TRACON.

BACKGROUND.

This effort was conducted in response to a request from the Western Regional Office for the Federal Aviation Administration (FAA) Technical Center to utilize its mockup techniques and facilities to develop a new equipment configuration for the Coast TRACON. This request resulted from an FAA decision to establish a Terminal Control Advisory (TCA) Service at the Coast TRACON. This additional service necessitated the expansion of the TRACON's operating postions. The region also opted to convert the facility's horizontal radar-island configuration to a vertical radar perimeter type. Project restrictions involved room size, maintenance constraints, and alteration costs. The Technical Center was also requested to investigate means by which the current room lighting could be improved.

Coast TRACON is a combined military and civilian Air Traffic Control (ATC) facility which is located at the El Toro Marine Corps Air Station in Santa Ana, California. The reconfigured TRACON will have a relatively short lifespan as plans are under consideration to merge the Coast TRACON with other FAA facilities.

SCOPE.

At a planning meeting between Technical Center and Western Region personnel, the following parameters were established for the refurbishment study:

1. The amount of space available to the Coast TRACON measured 38 feet long by 34.33 feet wide.

2. The wall separating the TRACON and maintenance rooms would be breached so radar displays could be pulled from the rear. (Airway Facilities personnel were reluctant to use this method as they felt it might infringe on the space required for the movement of equipment through the room.)

3. Most equipment would be relocated, as required, with the exception of the radar and beacon controls, the teletypewriter, and the military precision approach radar (PAR) equipment.

4. Ten vertical displays and associated operating positions would be included in the refurbished area. Shrouds and spacers would be standard equipment, issued by Oklahoma City.

5. The Technical Center would mock up the entire TRACON room. Although proposed configurations would be provided by the facility, the Technical Center would develop other arrangements.

FIGURE 1a. TWO VIEWS OF PRESENT COAST TRACON (SHEET 1 OF 2)

FIGURE 1b. TWO VIEWS OF PRESENT COAST TRACON (SHEET 2 OF 2)

6. The Technical Center would provide a small-scale model of the room and miniaturized consoles for initial study.

7. The Technical Center would develop a data acquisition desk and a supervisory desk for the refurbished facility.

8. Both in-line and arc equipment arrangements would be investigated during the study.

9. The facility Planning and Procedures Specialist would provide the Technical Center with information as to the types, sizes, and measurements of equipment to be included at each position.

10. The Technical Center would examine alternate types of lighting for the TRACON.

DISCUSSION

FOAMCORE/PLYWOOD MOCKUP STUDY.

A full-scale mockup which contained all of the positions and equipment presently found in the Coast TRACON was fabricated at the Air Traffic Control Facilities Configuration Laboratory. (See figures 2 through 7.) In consonance with this, the present day instrumentation, as used with the Coast TRACON horizontal displays, was located in the vertical console shrouds. Measurements were taken which made it apparent that the overhead frames or shrouds that contain various equipment and controls which can accommodate present day equipment would not be able to meet the requirements for planned, futuristic instrumentation. A divider was used to mark the limits of the floor space associated with the El Toro PAR equipment which was not depicted.

Since the existing Coast TRACON equipment was intended for military use, many units, such as runway visual range (RVR) and telecommunications, are not considered to be standard for FAA facilities.

The Technical Center team created four combinations of equipment positioning for evaluation in addition to those designed by the Western Region representatives. Once the Technical Center personnel translated the designs into scale models, Western Regional office and field personnel visited the Center to evaluate the designs. During the evaluation process, Technical Center personnel explained the reasons for each specific configuration and offered comments on their utility. Subjective opinions from Western Regional personnel provided the basis of the evaluations.

The Coast TRACON personnel were all shown a new planned modular supervisory complex, that the Technical Center developed for the Airway Facilities Service, which provided a suitable design for TRACON use. The console design was based upon a modular concept developed at the FAA Technical Center for the Airway Facilities Service. Being modular, it can be adapted to the size and shape of the room space available at any terminal facility. Two Data Acquisition and Distribution System (DADS) console designs were tested, a "lowboy" and a "highboy."

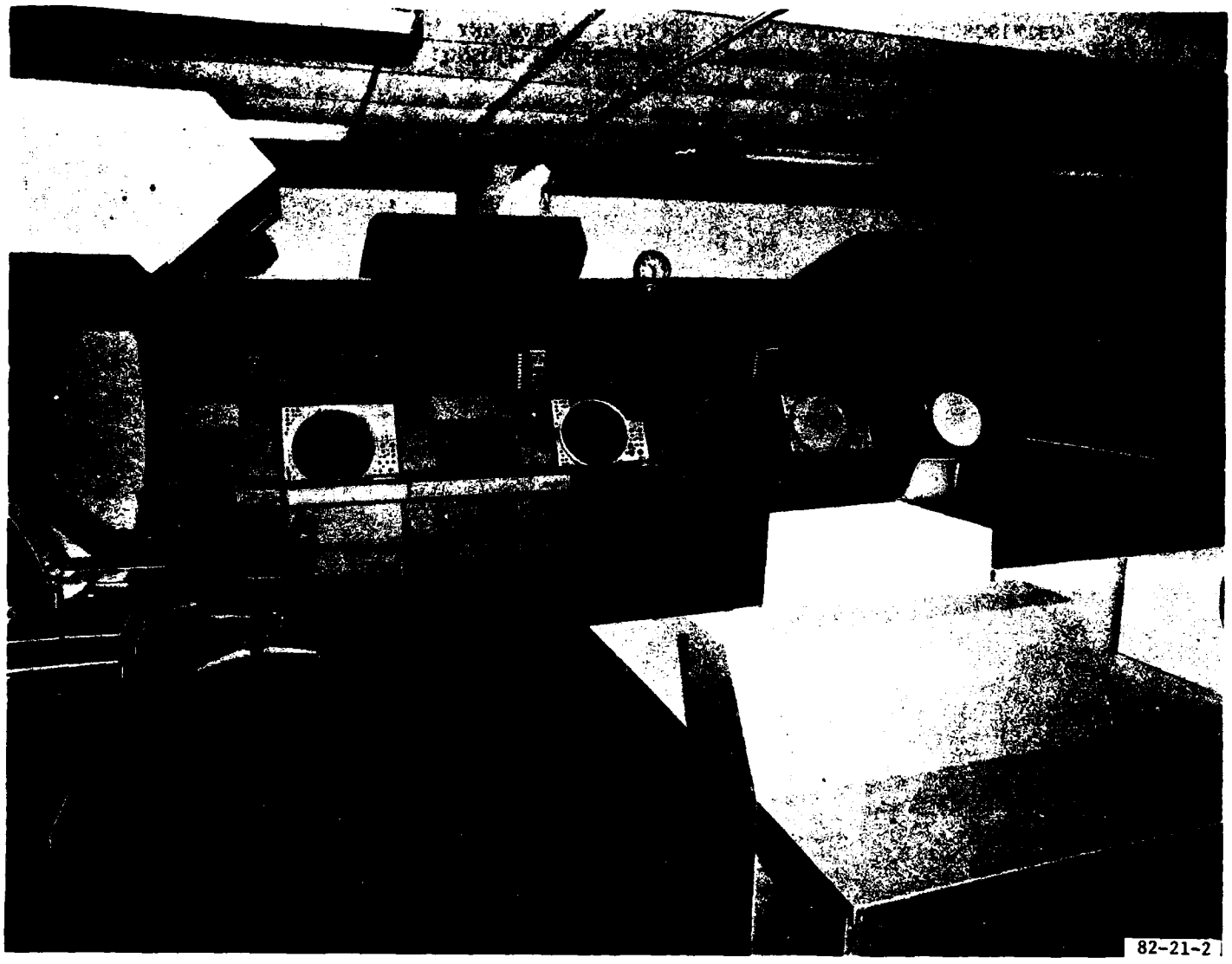


FIGURE 2. "LOWBOY" DADS CONSOLE (FOREGROUND), RADAR AND HANDOFF CONSOLES (BACKGROUND)

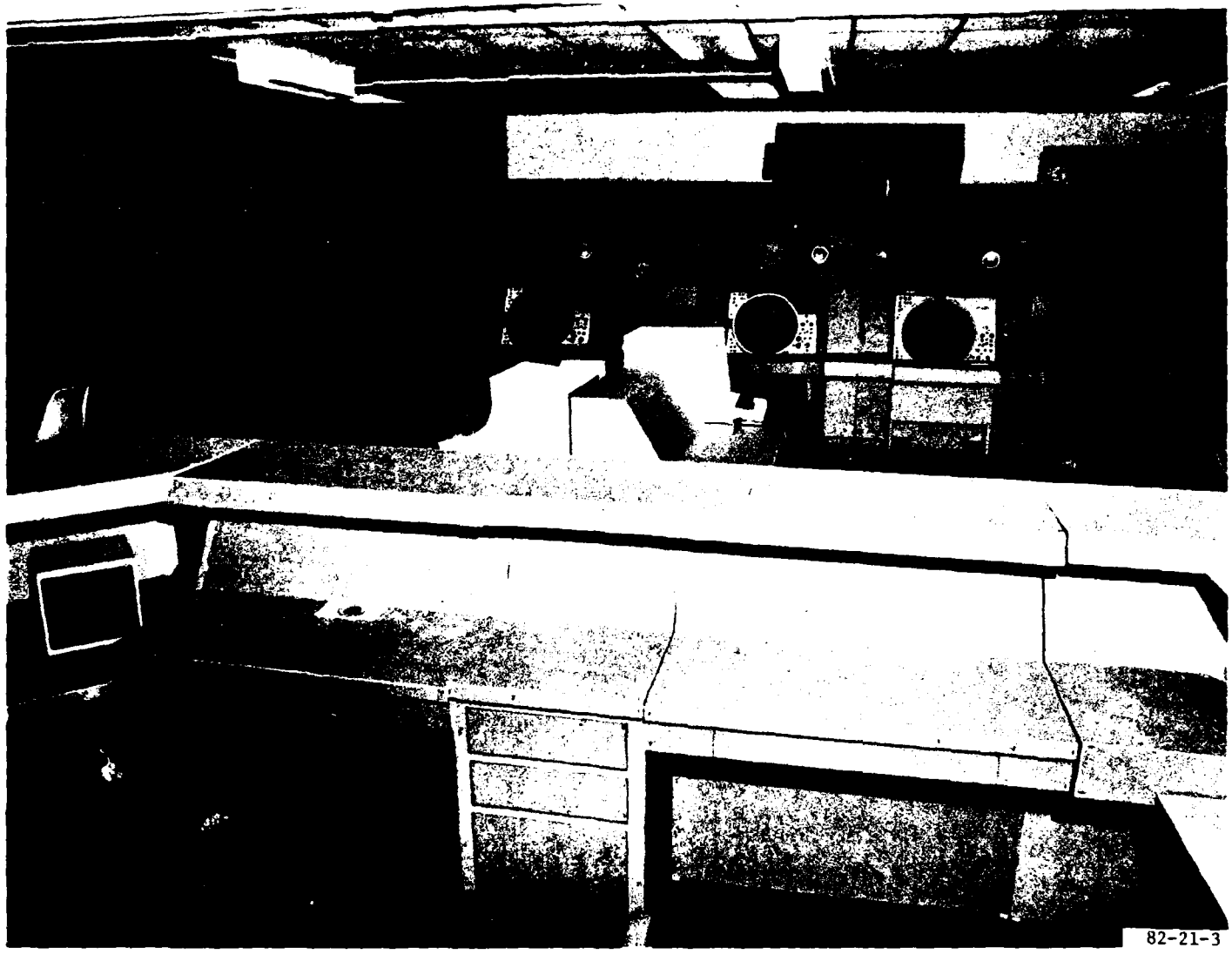


FIGURE 3. SUPERVISORY CONSOLE (FOREGROUND); "LOWBOY" DADS CONSOLE AND NEWPORT, PEDRO, BEACH, AND HARBOR DISPLAYS (BACKGROUND) PLUS ASSOCIATED HANDOFF POSITIONS

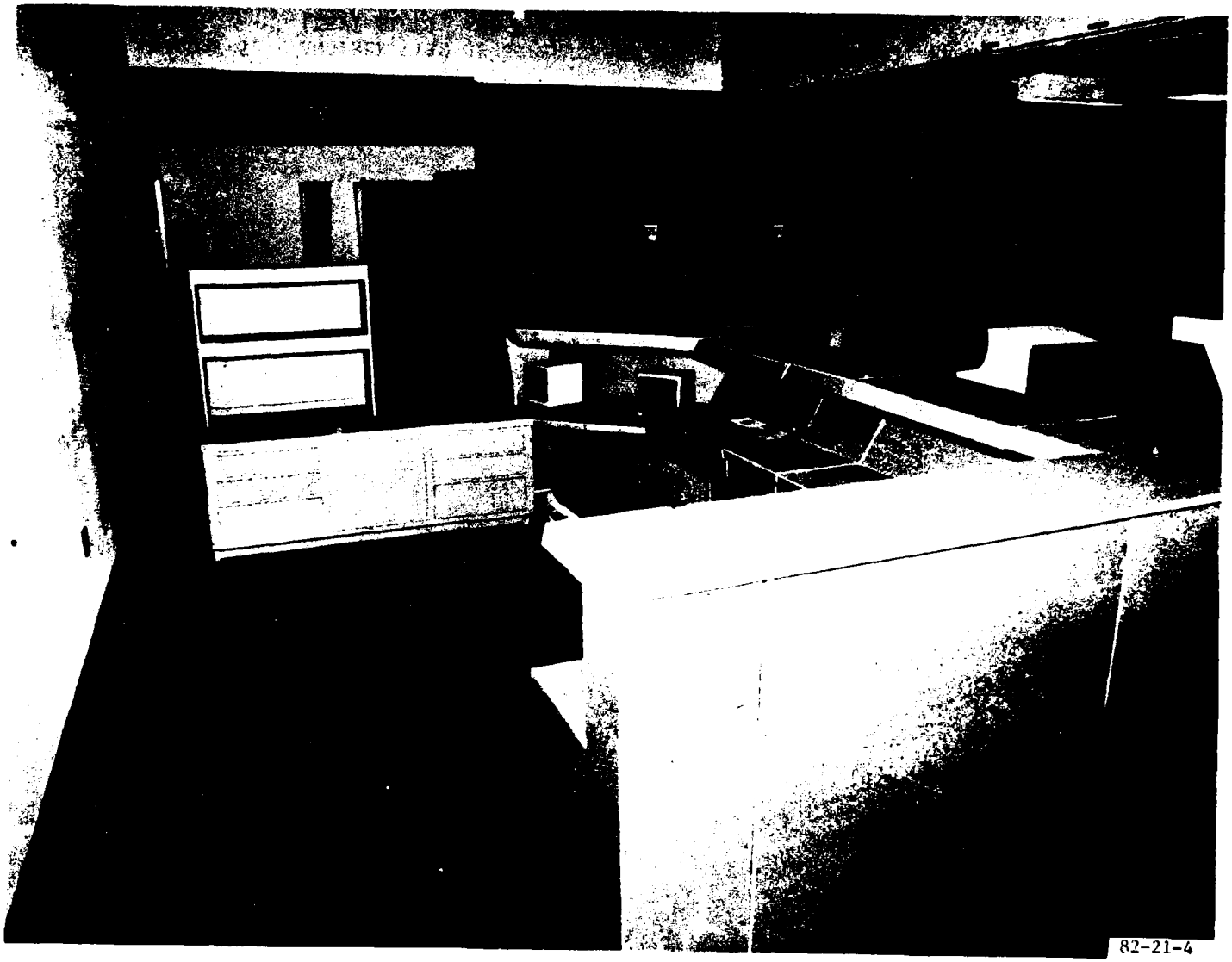


FIGURE 4. SUPERVISORY CONSOLE (FOREGROUND); DUKE, ORANGE, AND TUSTIN DISPLAYS (BACKGROUND) PLUS ASSOCIATED HANDOFF POSITIONS

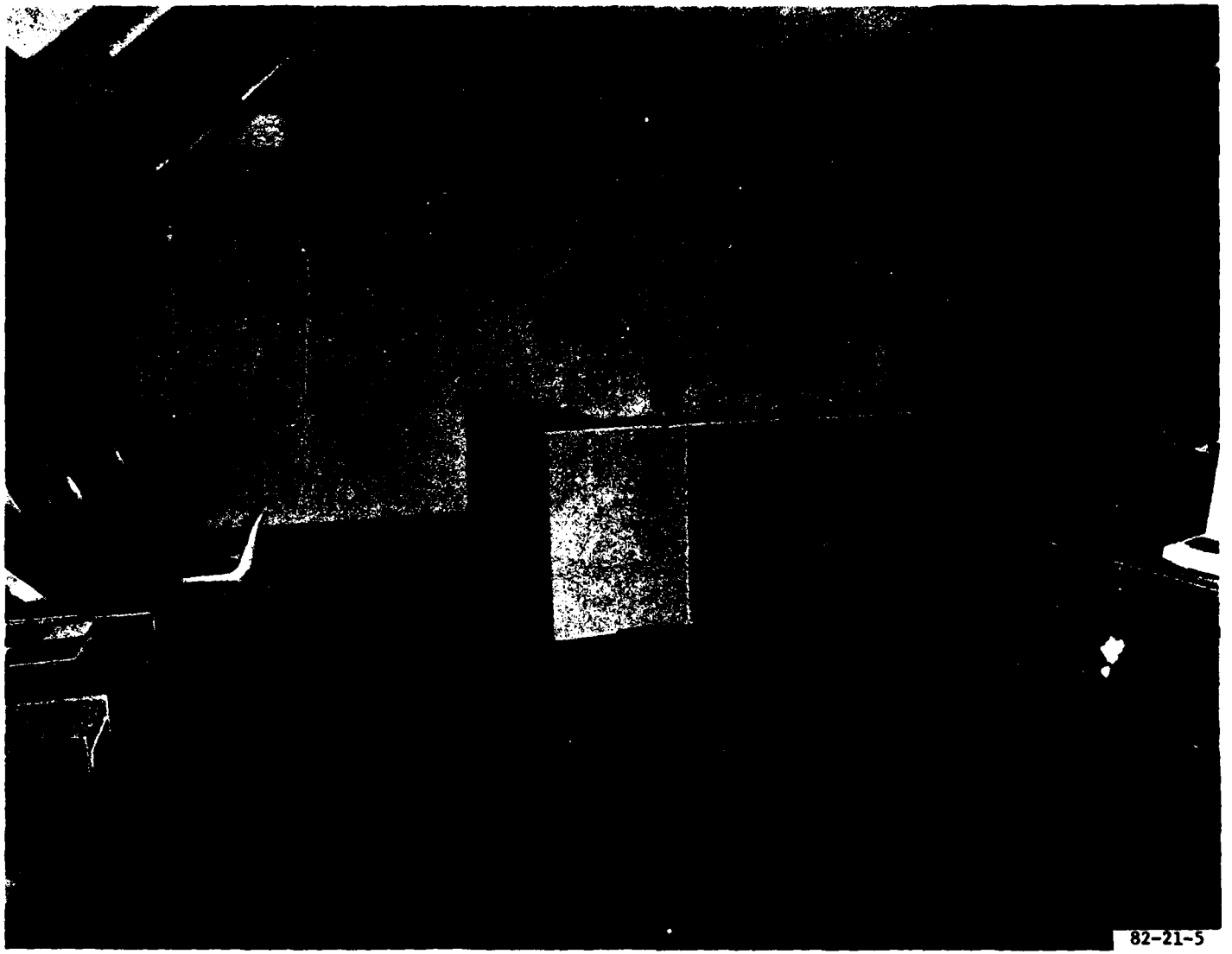


FIGURE 5. ANOTHER VIEW OF SUPERVISORY CONSOLE (BACKGROUND), RADAR DISPLAYS (LEFT SIDE), AND PARTIAL "LOWBOY" DADS (RIGHT SIDE)

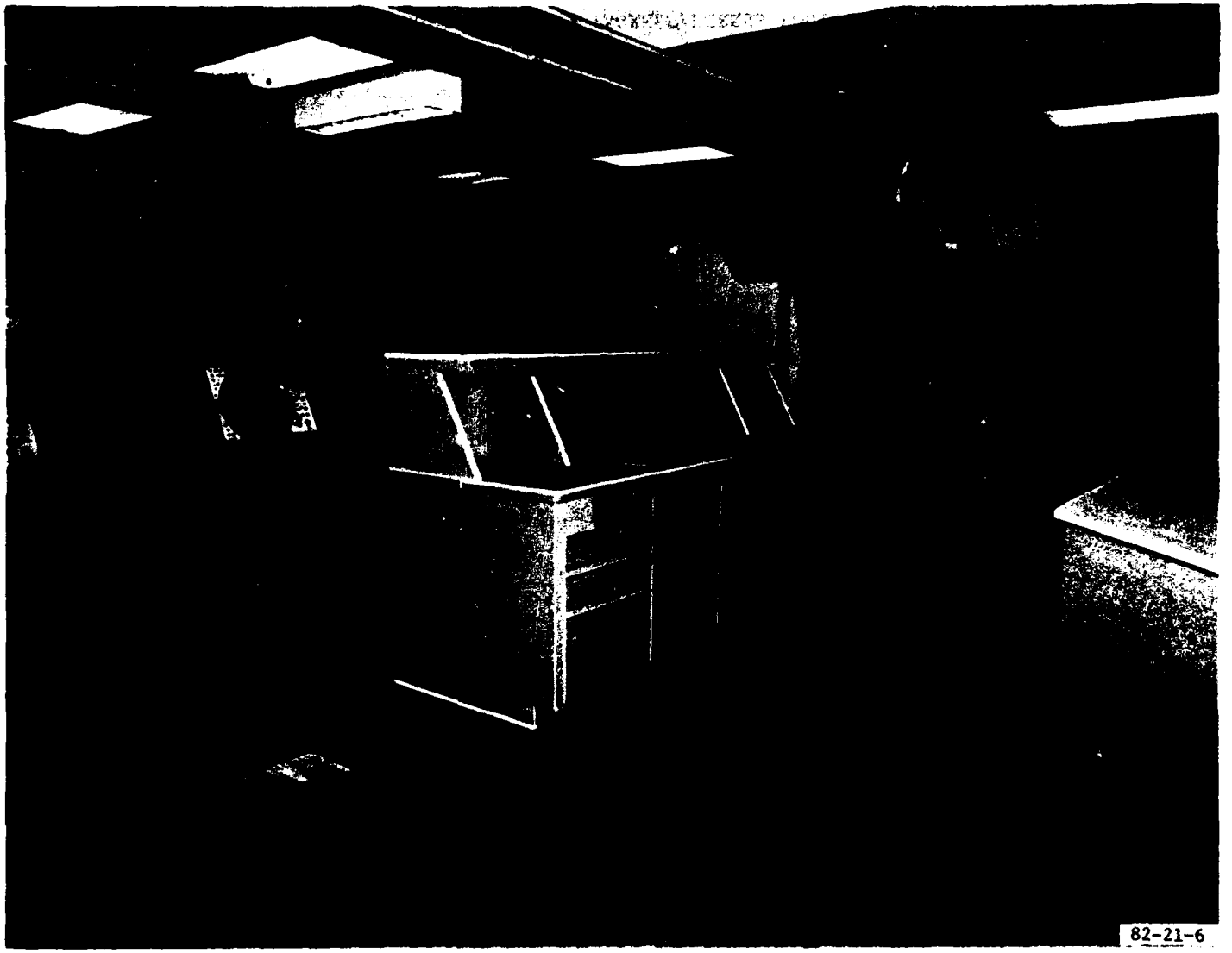


FIGURE 6. "HIGHBOY" DADS CONSOLE, VARIOUS RADAR DISPLAYS (LEFT AND RIGHT BACKGROUND) PLUS ASSOCIATED HANDOFF POSITIONS

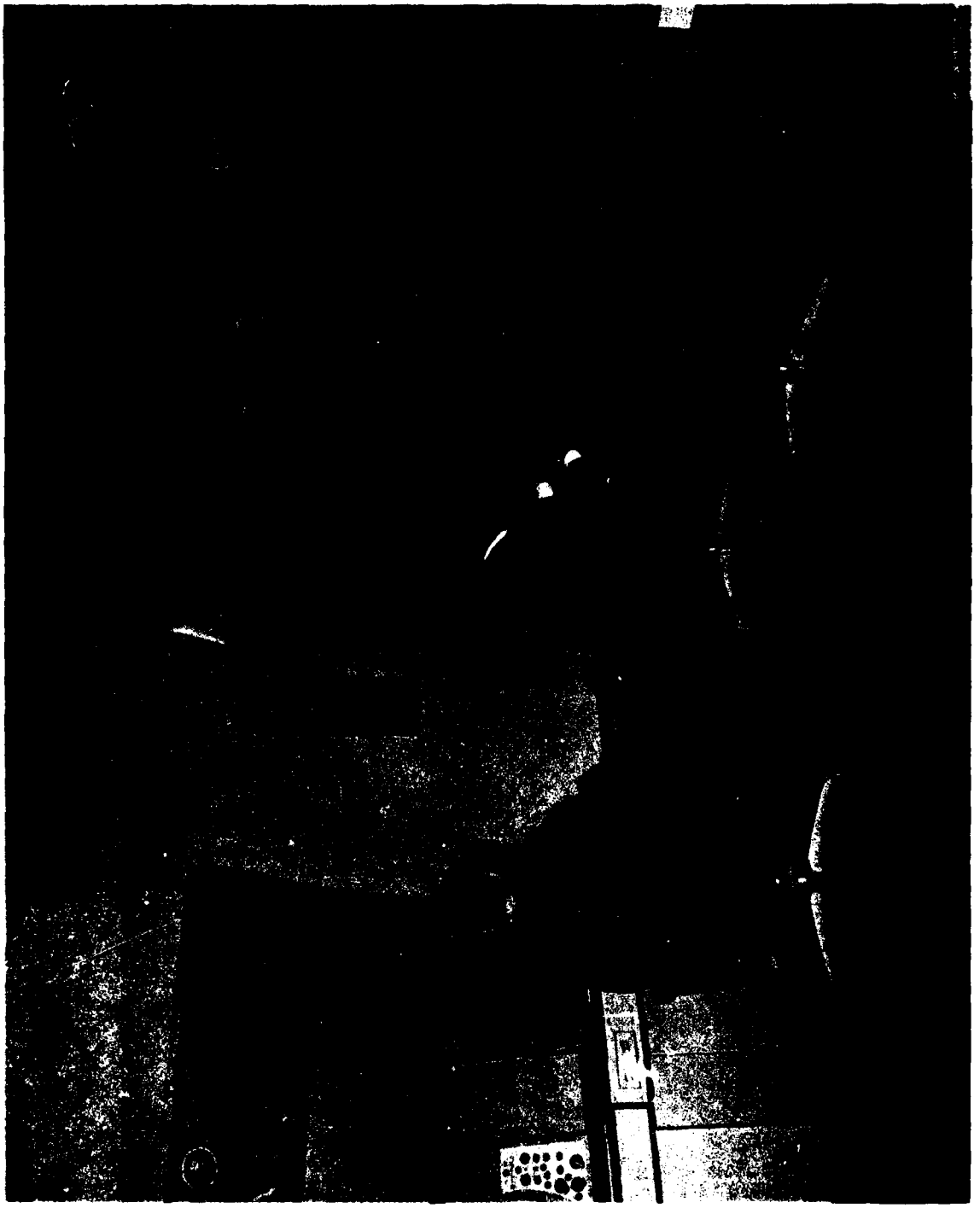


FIGURE 7. MAIN INGRESS/EGRESS ROUTE

SCALE MODEL STUDY.

Several plans were developed jointly by the Technical Center and Western Region which would facilitate the proposed reconfiguration of the present TRACON with minimal disruption. Scale models of eight configurations were produced, and photographs were taken of each (figures 8 through 15). A discussion of each configuration follows (references are made to A, B, C, and D areas as indicated on the illustrations).

Each of the proposed configurations was labeled and photographed. These photographs were viewed and evaluated by the participating air traffic control specialists. There were two flight data consoles tested, a "lowboy" and a "highboy." In all configurations, one or the other was positioned either in the center of the TRACON or on the D side, abutting the wall. Although the supervisory console is presently located on the C side where the supervisor can oversee the entire operation, it was positioned some distance from the master radar and beacon controls. The supervisory console depicted in every case is not the one presently in use at the Coast TRACON, but follows the design of a modular supervisory console developed at the Technical Center.

CONFIGURATION 1 (FIGURE 8). As in all configurations, except 8, the consoles housing the El Toro control positions in the A area remained undisturbed. These consoles separated the Coast TRACON from the portion of the room in which the military PAR positions were located. The satellite positions of Duke, Orange, and Tustin, along with handoff and coordinator consoles, were placed along the D side along the wall nearest the main ingress/egress route (upper left corner) where the master radar and beacon controls were located. This row of consoles is situated so that its rear is located 3 feet from the wall, which is the minimum distance required for maintenance personnel to work on the equipment without removing the displays. The satellite positions of Newport, Pedro, Beach, and Harbor, together with their two coordinator positions and overhead booms were located on the B side. These were set into the wall which was breached for this purpose. This was done in such a manner that the rear of the consoles was flush with the inside of the maintenance room wall. The consoles could not be allowed to intrude into the maintenance area as the entire aisle along this wall was required to move equipment in and out of the building.

CONFIGURATION 2 (FIGURE 9). The only variation from configuration 1 was the wall along the maintenance area was not breached and the line of equipment consoles on the B side was moved 3 feet in from the wall in order to provide sufficient room for maintenance operations. It can be seen from figure 9 that this arrangement definitely reduced the amount of usable floorspace in the center of the room. It also reduced the space available to maintenance personnel for the movement of radar displays between the operations and maintenance areas. The positioning of the consoles in this manner also posed a problem by allowing barely enough space to clear the supervisory console if such a console were to be built and utilized. It would also hinder the use of the second door into the maintenance room which is located in the corner of the room in the lower right-hand corner of the figure. This door is not wide enough for the movement of such equipment as radar displays, only the door on the other end of the room, same side, is wide enough to accommodate the radar displays.

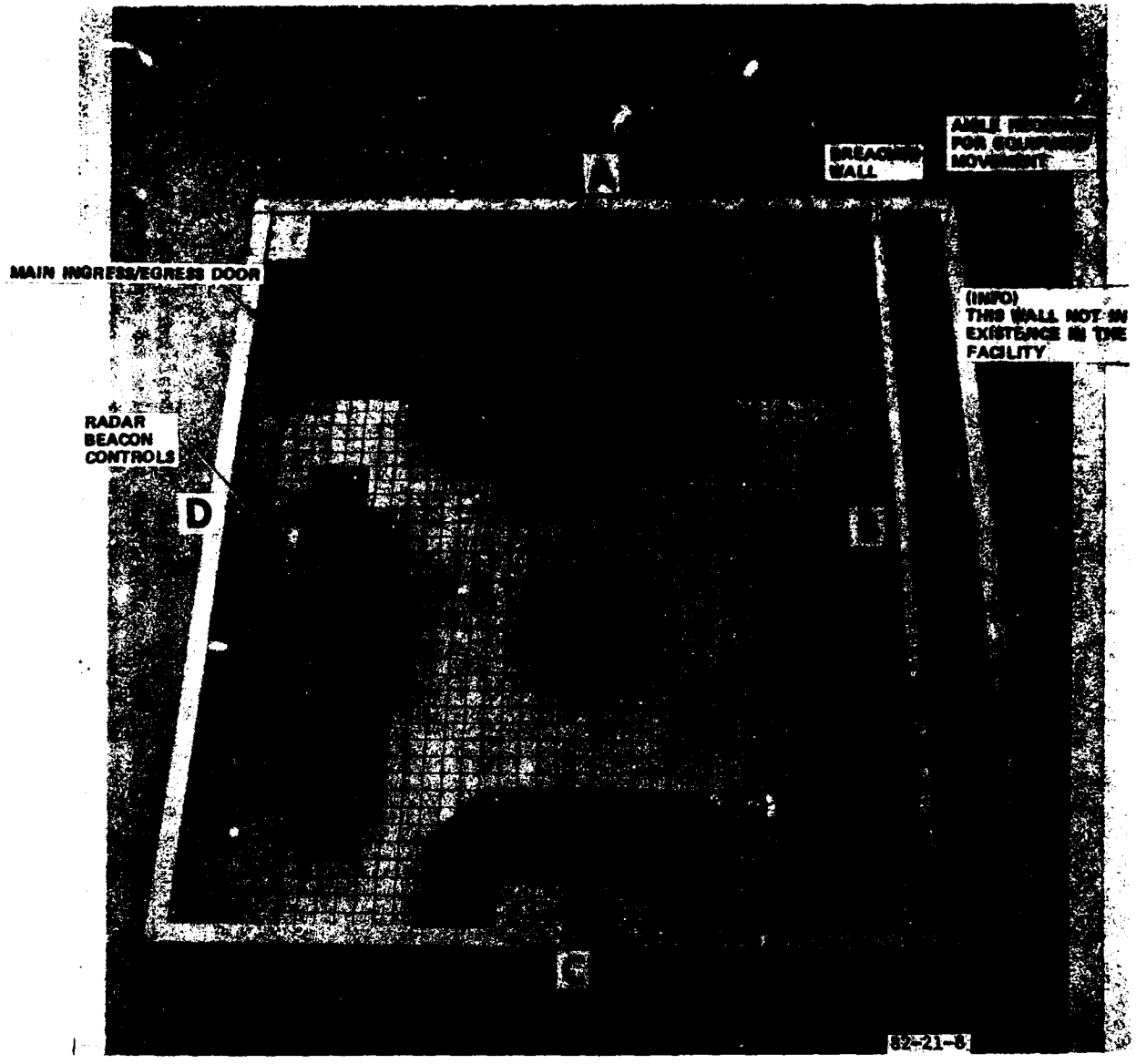


FIGURE 8. CONFIGURATION 1

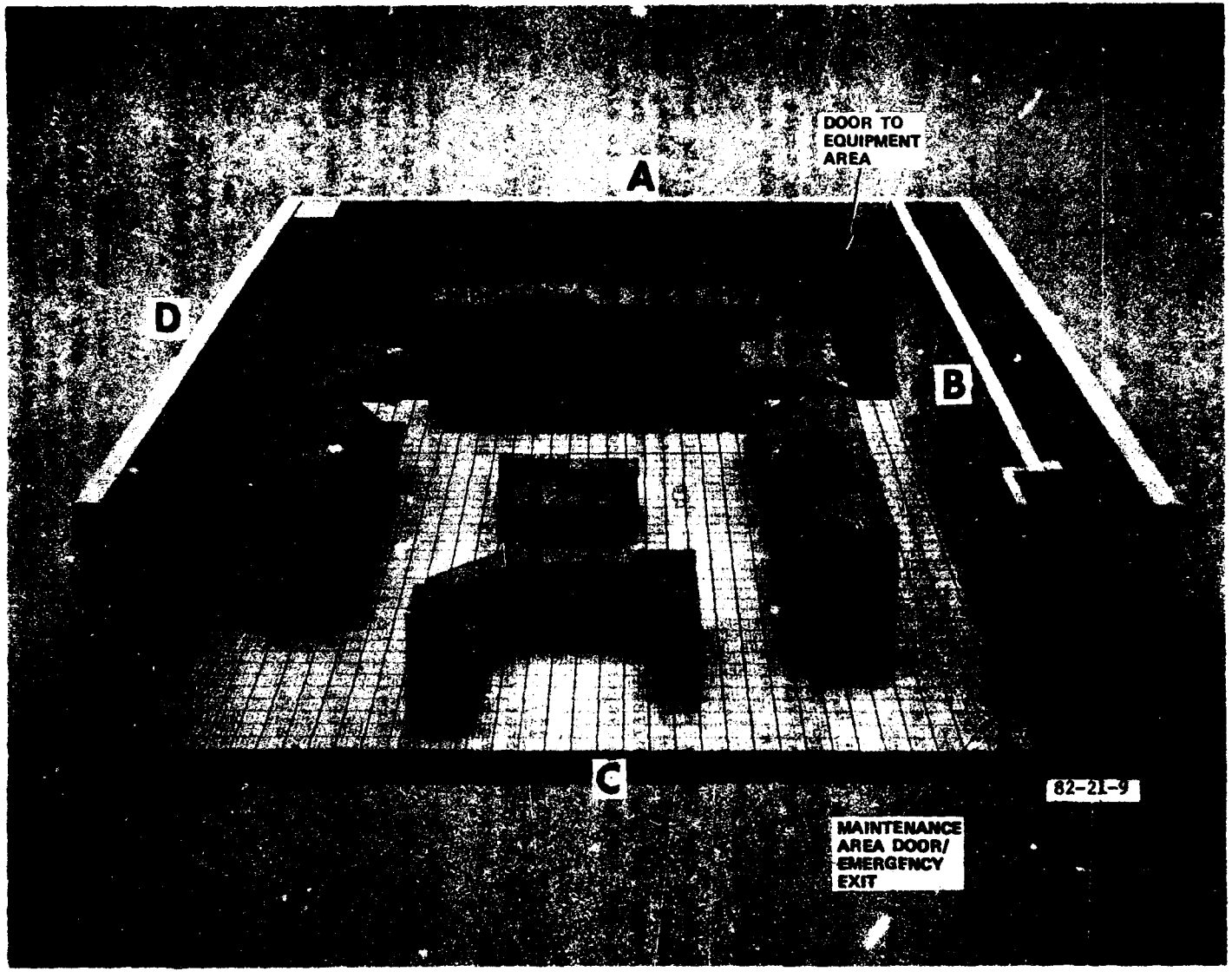


FIGURE 9. CONFIGURATION 2

Airway Facilities personnel favored this or other configurations which did not penetrate the wall into the maintenance area because (1) they felt it would infringe upon the needed aisle along that wall on the maintenance room side; (2) conversion from the present day configuration to the new configuration could be accomplished in a much shorter time frame and at a considerable savings in cost.

CONFIGURATION 3 (FIGURE 10). This configuration exchanged the consoles which were along wall B with those along wall D. The rationale for this arrangement was to recess the shorter of the two rows into a breach in B wall in order to provide better access to the maintenance room doorway. Following this switch, one problem area that was noted was the close proximity of consoles on the D side to the supervisory console. This could be disconcerting for both the Assistant Chief and the operational positions.

The consoles along wall D, being longer, also reduced the space between the far ends of the console and the end of the console along wall A. Since the area between the two rows of consoles was the main ingress and egress route for the control personnel, this could prove to be disconcerting to those controllers positioned at the ends.

In addition, the longer console to some extent made the access to the main radar and beacon controls more difficult. Positioning the supervisor desk along wall C, as proposed by the facility, remoted the supervisor from the radar and beacon controls and forced the supervisor to walk across the room in order to effect any changes.

CONFIGURATION 4 (FIGURE 11). This arrangement varied from configuration 3 only in that the line of equipment consoles in the B area was moved a distance of 3 feet away from the maintenance room wall which was not breached.

This configuration, as in configuration 2, reduced the usable floor space in the center of the room. Space between the supervisory desk and control positions which are located in close proximity to the desk was minimal and could be distracting to controller and supervisor. Space available for personnel to pass through the area to the right of the supervisor's desk, as depicted in figure 11, to use the exit in the lower right-hand corner, was minimal. Frequent use of this exit could be distracting to the controllers at this end of the console.

The problem with the proximity at the ends of the consoles along wall D and wall A near the main ingress, egress door was aleviated in both configuration 3 and 4 by moving the consoles (along wall D) closer to wall C which provided additional space for the movement of personnel.

CONFIGURATION 5 (FIGURE 12). Configuration 5 was another variation of configuration 1 in which the line of consoles along wall D was exchanged with the supervisory console. As a result, the supervisory console had the master radar and beacon controls in close proximity to facilitate necessary changes. The relocation of the original D side satellite consoles to the C side posed no problem for the DADS position as it remained about the same distance away. Another advantage was that controllers reporting for duty or reentering the control room would have easy access to read files, sign-in logs, and duty rosters without having to cross the control room.

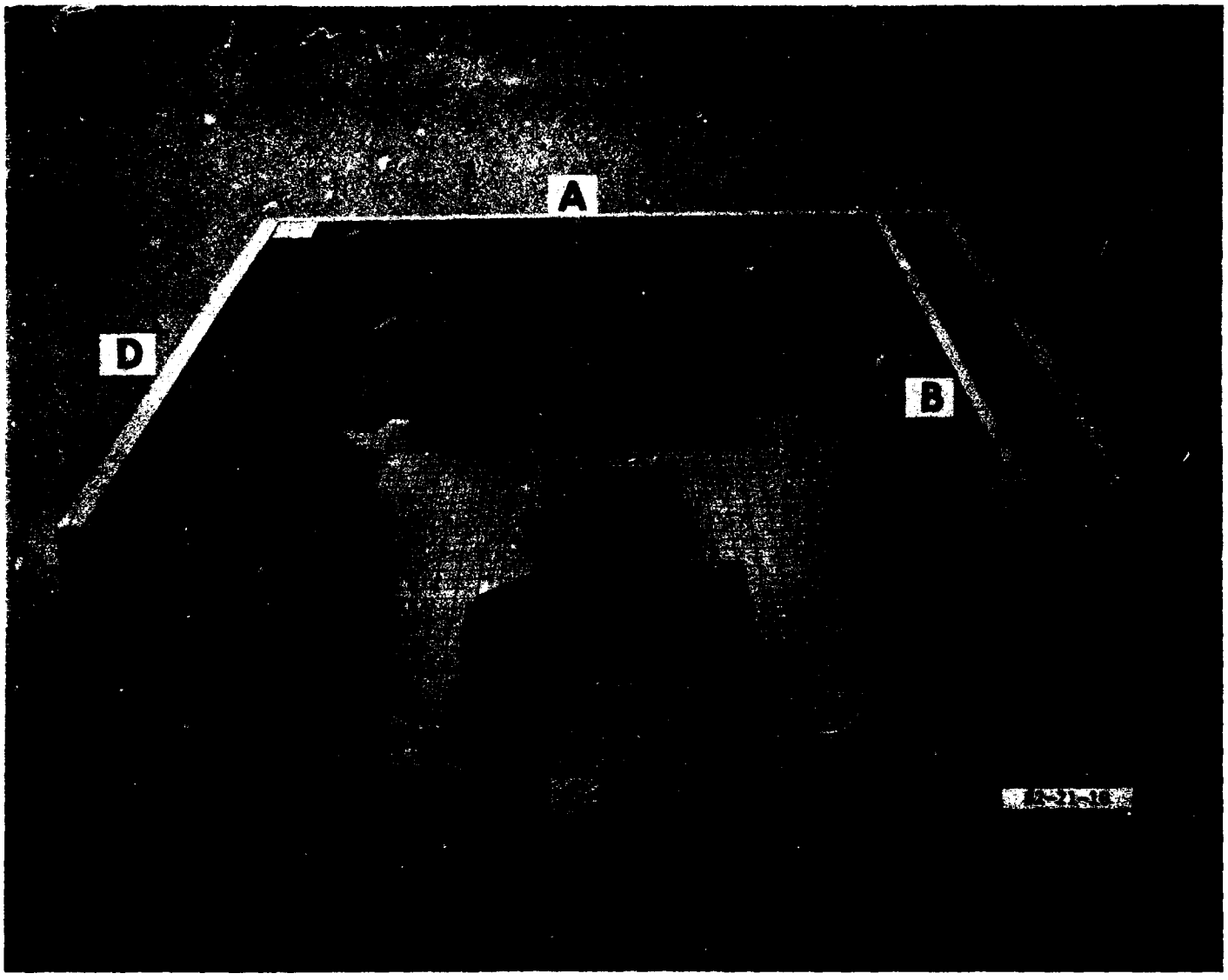


FIGURE 10. CONFIGURATION 3

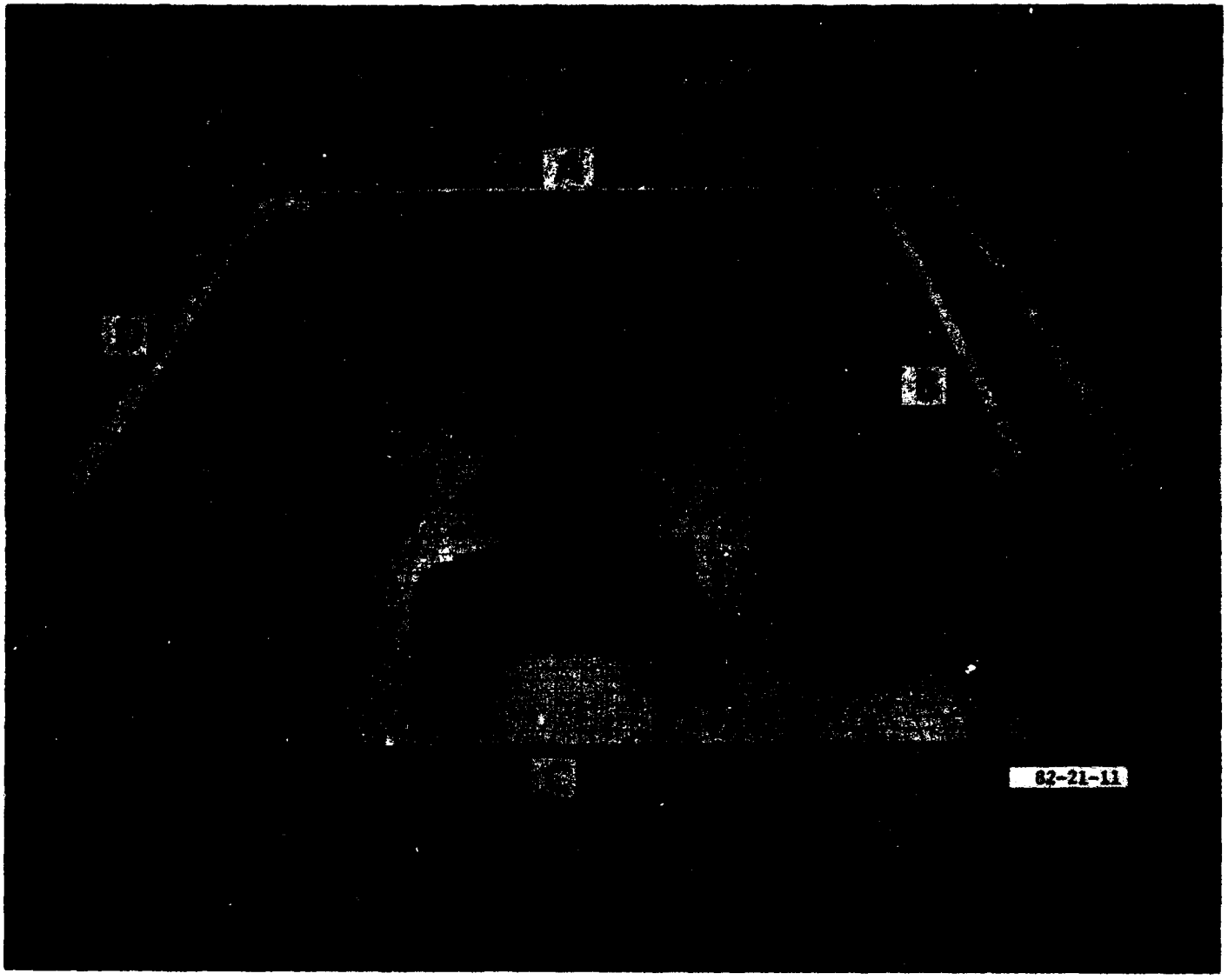


FIGURE 11. CONFIGURATION 4

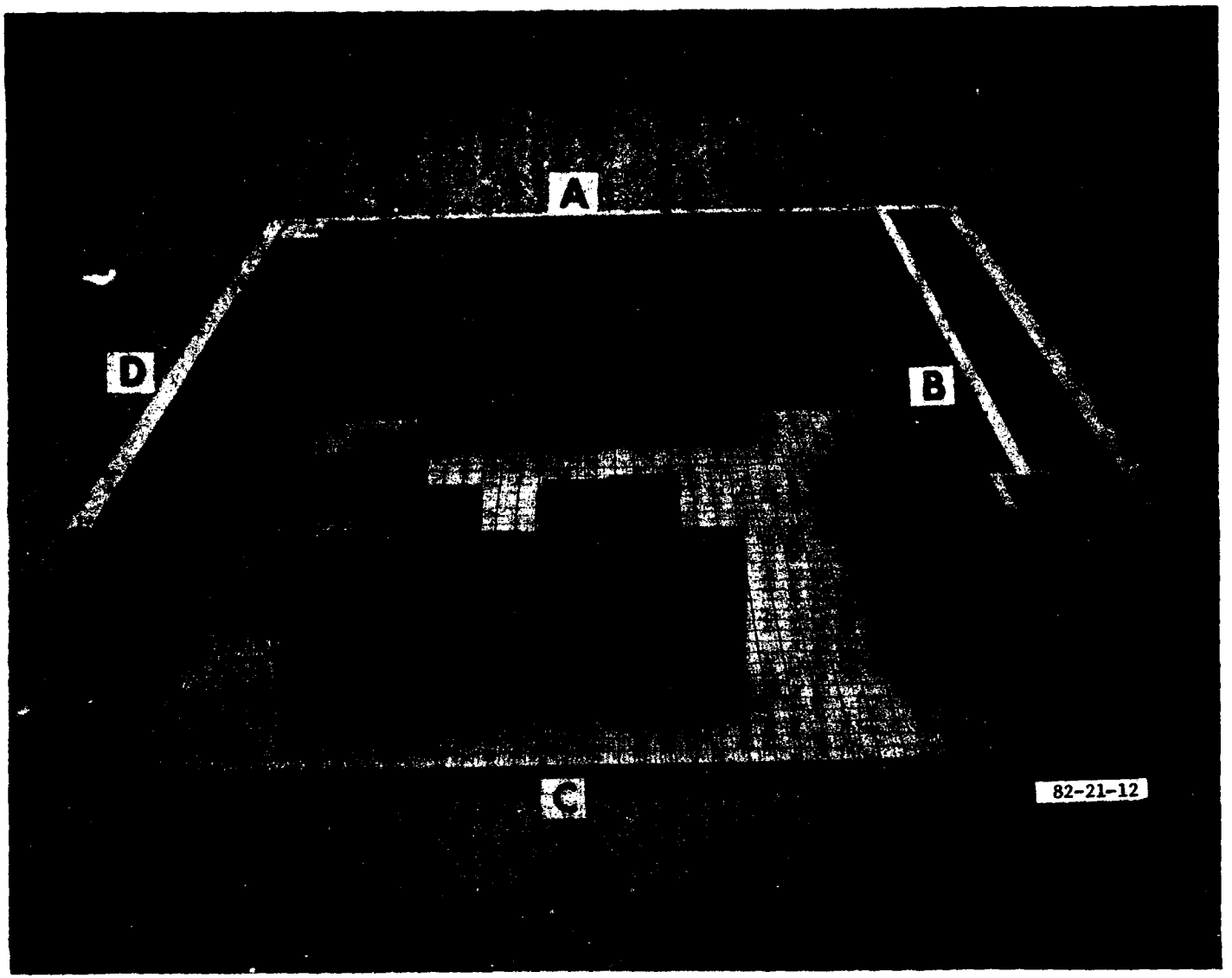


FIGURE 12. CONFIGURATION 5

CONFIGURATION 6 (FIGURE 13). The only change from configuration 5 was the movement of the B line of consoles 3 feet away from the maintenance wall which was not breached. This placement of those consoles again limited the available space at the far end of the console and the end of the consoles along A. Here radar displays could not be removed from the TRACON or brought into the TRACON without interferring with the controllers at the end positions. Those controllers would have to move away from the control positions until the equipment passed through the area.

Here too, if heavy use were made of the doorway in the lower right-hand corner of the room (figure 13), there could be some distraction to the controllers working at the positions at this end of the consoles due to their close proximity.

CONFIGURATION 7 (FIGURE 14). Configuration 7 was basically the same as configuration 5 except that the DADS position was moved to the D side and the consoles along wall B were recessed into the wall. This arrangement opened up the center of the floor. Its only disadvantage would be the additional distance flight data personnel would be required to travel to and from the control sector. This appeared to be the best configuration because there was more than enough walking room in the central area, and the ingress/egress route was open. The other two areas which provided entry into the maintenance area were relatively open also. Since the consoles along wall B did not actually intrude into the maintenance area, Airway Facilities personnel found the configurations acceptable.

CONFIGURATION 8 (FIGURE 15). Configuration 8 was the same as configuration 7 with the following exceptions: The consoles along wall B were placed 3 feet away from the wall and the wall was not breached. In an attempt to provide space between the far end of the consoles for maintenance to move equipment through, with less distraction to the controllers, the consoles along walls A and C were moved to the left, 2 feet. This did provide additional space, however, this did not eliminate the necessity of the movement of those controllers at the end positions when large equipment would have to be moved through that area between A and B. During the evaluation process, the Coast TRACON personnel were shown a new modular supervisory complex (figure 4). The proposed location for this was near the entrance door close by the radar and beacon master controls. Also shown were two modular DADS positions; one was a specially designed "lowboy" version which allowed location in the center of the room with task lighting via Lightolier" fixtures from the ceiling (see figures 2 and 3); the other was a two-Flight Data Entry Position (FDEP) "highboy" with self-contained lighting which was planned for a wall position (figure 6).

GRAPHIC STUDY.

Another configuration which was considered was that of the "U" equipment arrangement. (See figure 16.) This configuration was provided by the Western Region. The alcove which contains the United States Marine Corps air traffic control area is depicted as wall A in configurations 1 through 7. The Western Region added some consoles which were not depicted in the other studies. A Technical Center draftsman made a graphic study of this configuration and found it would not fit within the allotted area, as proposed, and still leave enough room to transport consoles in and out of the TRACON room into the maintenance area for servicing.

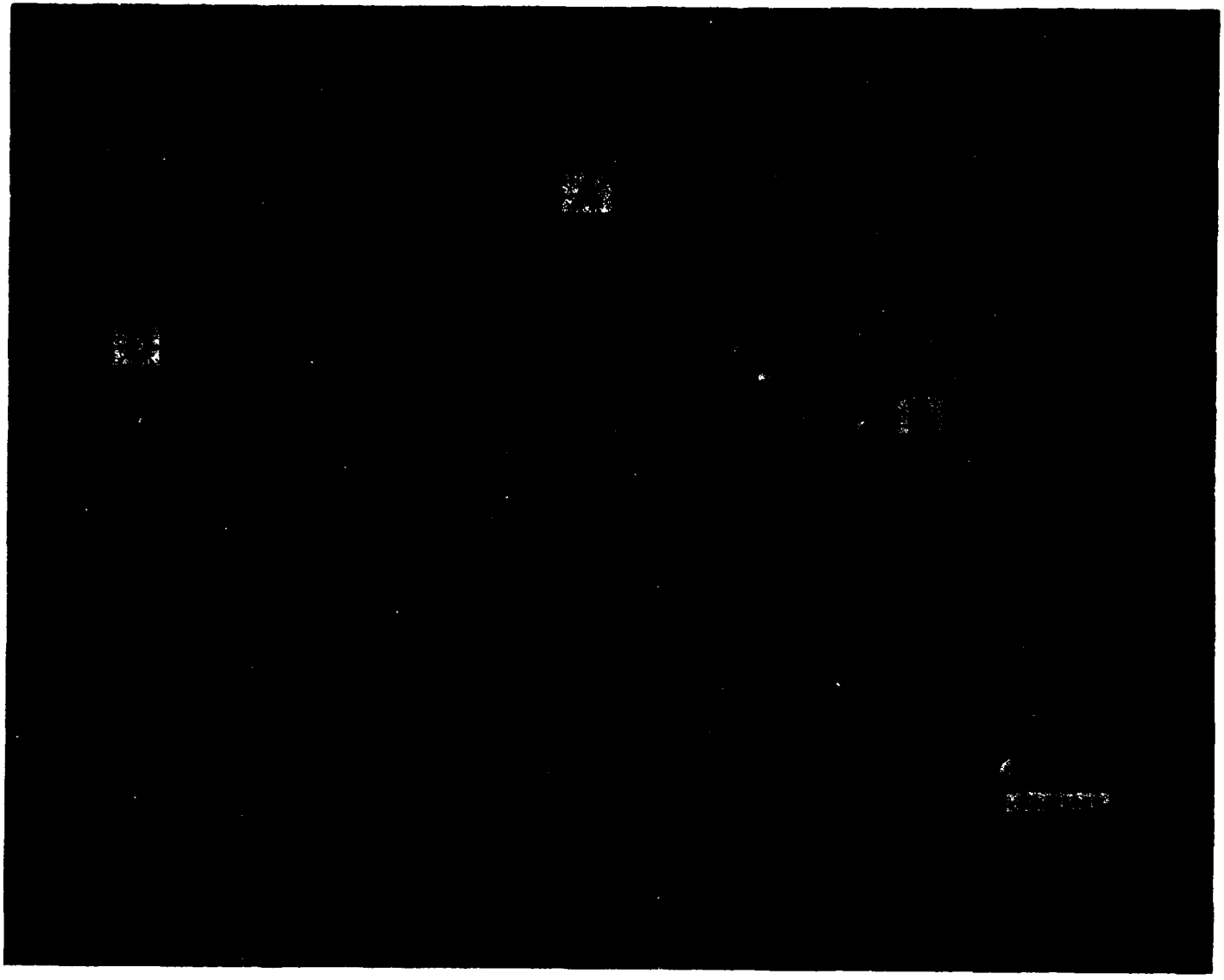


FIGURE 13. CONFIGURATION 6

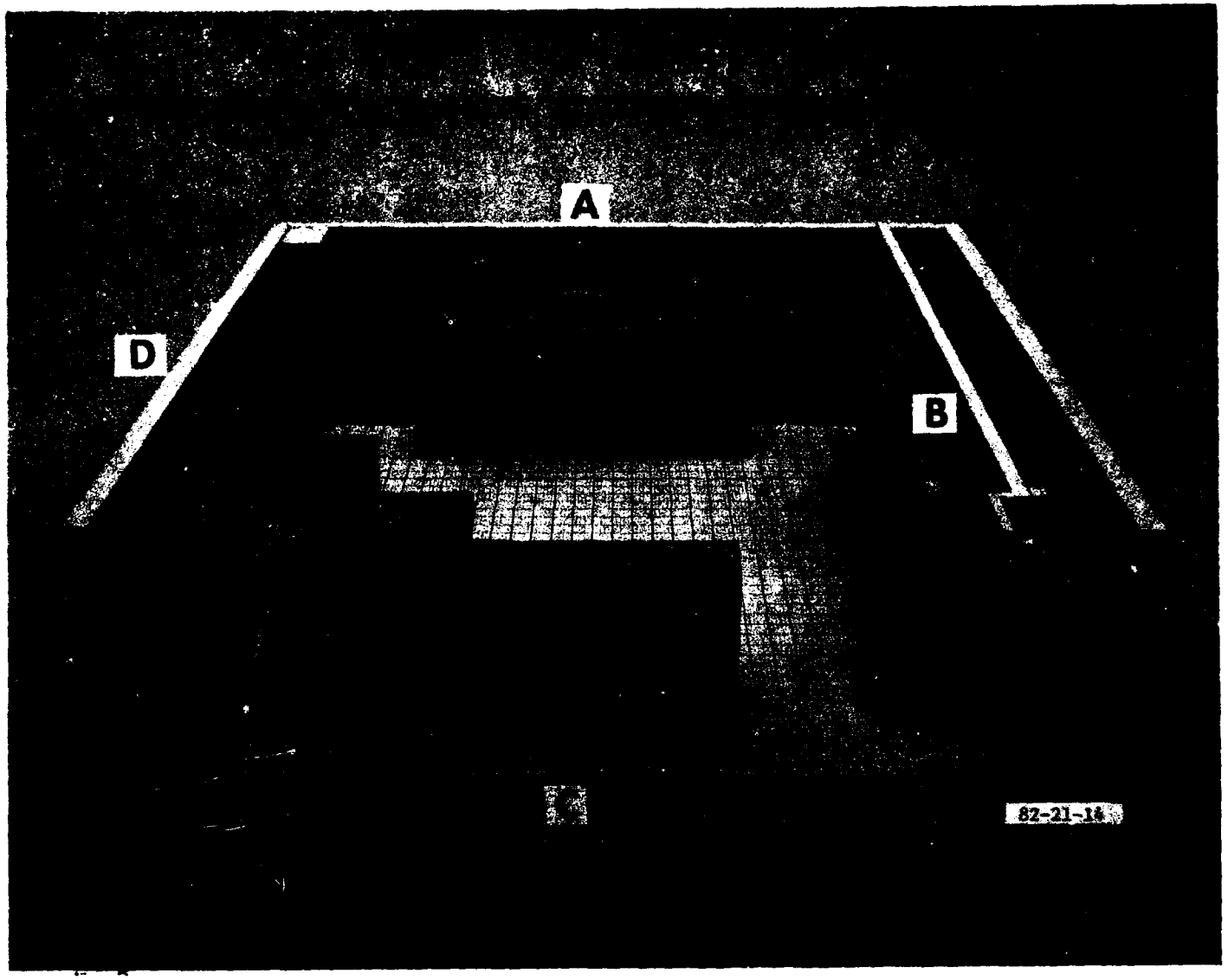


FIGURE 14. CONFIGURATION 7

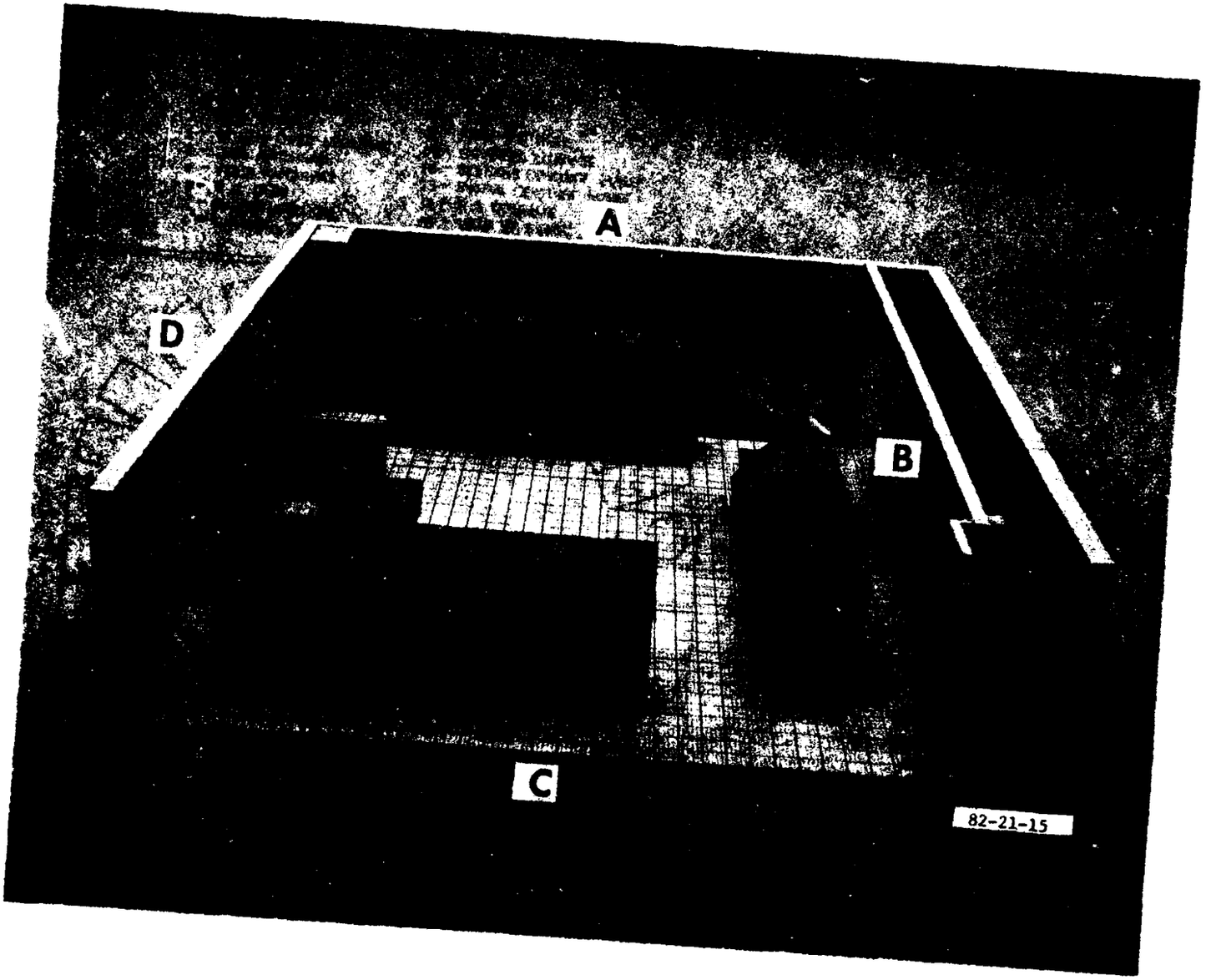


FIGURE 15. CONFIGURATION 8

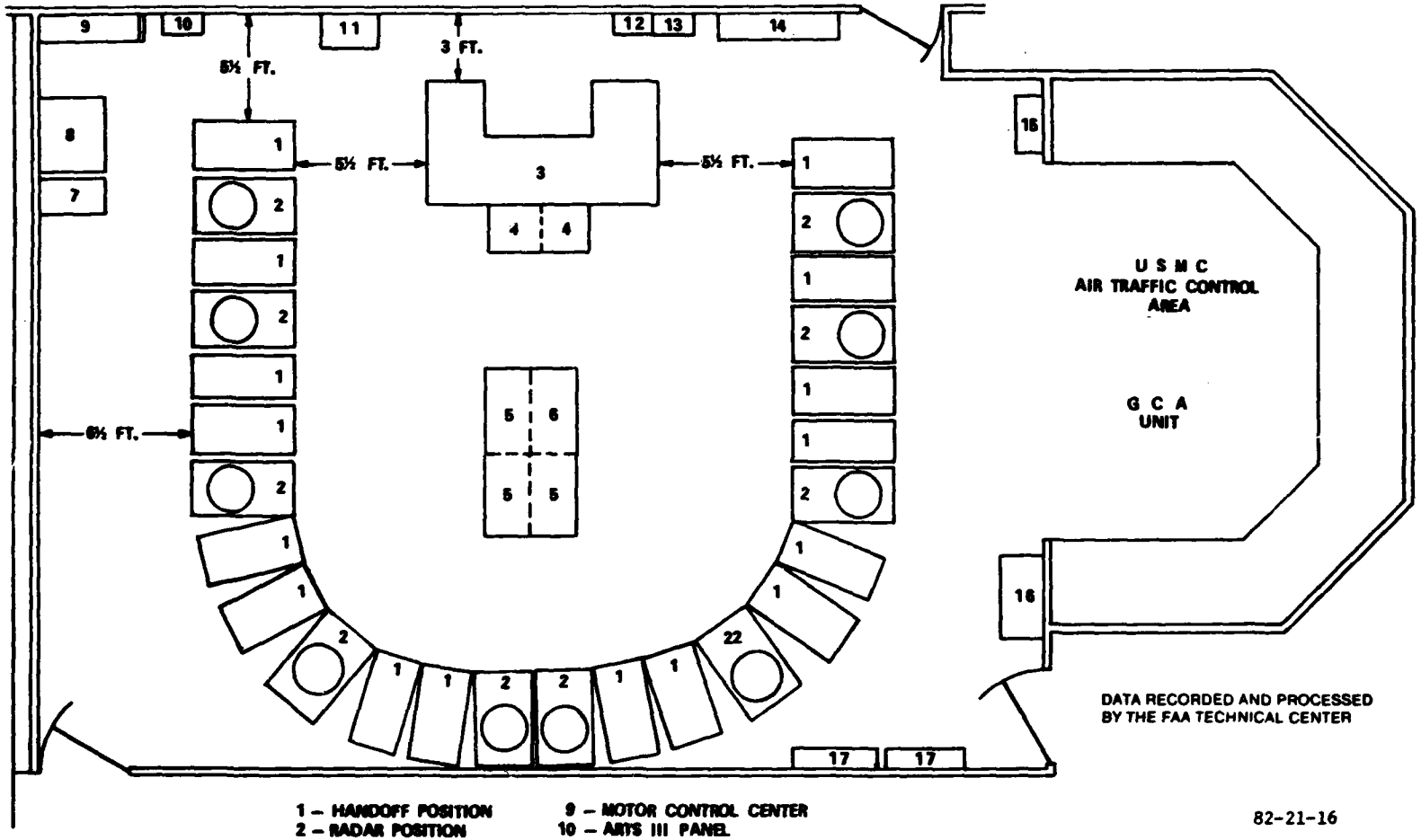


FIGURE 16. PROPOSED "U" SHAPE CONFIGURATION

LIGHTING STUDY.

TRACON lighting has always been a problem as related to the size of the room and the type of lighting used. Conditions such as reflections on radar displays and uneven ambient light levels produce glare in some areas and "black holes" in others. Coast TRACON, like many others, has experienced these problems, and the Technical Center was requested to provide suggestions to relieve them. As a result of previous Technical Center research into the problem, an answer has been devised. Using a very soft light, called Ultralume Fluorescence, a method known as "wall washing," which employs lighting fixture troughs and dimmer switch controls, proved effective. (See figures 17, 18, and 19.) Placement of each trough is important as it serves a twofold purpose: (1) lighting the floor area behind the consoles which allows maintenance personnel to conduct repair activities to equipment, and (2) directing light upward to wash the walls and ceiling which were painted with a dark, flat paint and produced even, glare-free ambient room lighting levels. Providing this twofold capability would require a trough-type fixture which is open both on top and bottom. Another innovation which can be found at some other facilities makes use of dark colored carpeting to cover wall areas. This material would both reduce wall light reflections and lower the ambient noise level. If a determination was made that the flight data position would be more advantageous in the center section of the TRACON, lighting for it could be accomplished through the use of well positioned Lightolier framing lights. These lights can be pinpointed upon the area in use and usually cause no spillover of light to other positions.

CONCLUSIONS

As a result of this study and evaluation, it is concluded that:

1. Configuration 7 is the most useful as it provides the maximum working and walking space with minimum impact upon the existing facility.

2. The ambient lighting of the TRACON should be free of reflective glare, and the "wall washing" process would do much to alleviate this problem.

3. The present shrouds above the radar and handoff consoles will be inadequate for use with planned, futuristic instrumentation.

RECOMMENDATIONS

Based on the above conclusions, it is recommended that:

1. A physical equipment change be made to the Coast Terminal Radar Approach Control Facility (TRACON) which incorporates the innovations of configuration 7.

2. The "wall washing" lighting technique be implemented to relieve reflective glare on radar displays.

3. New radar and handoff console shrouds be developed which will accommodate not only present-day instrumentation, but that planned for the immediate future.

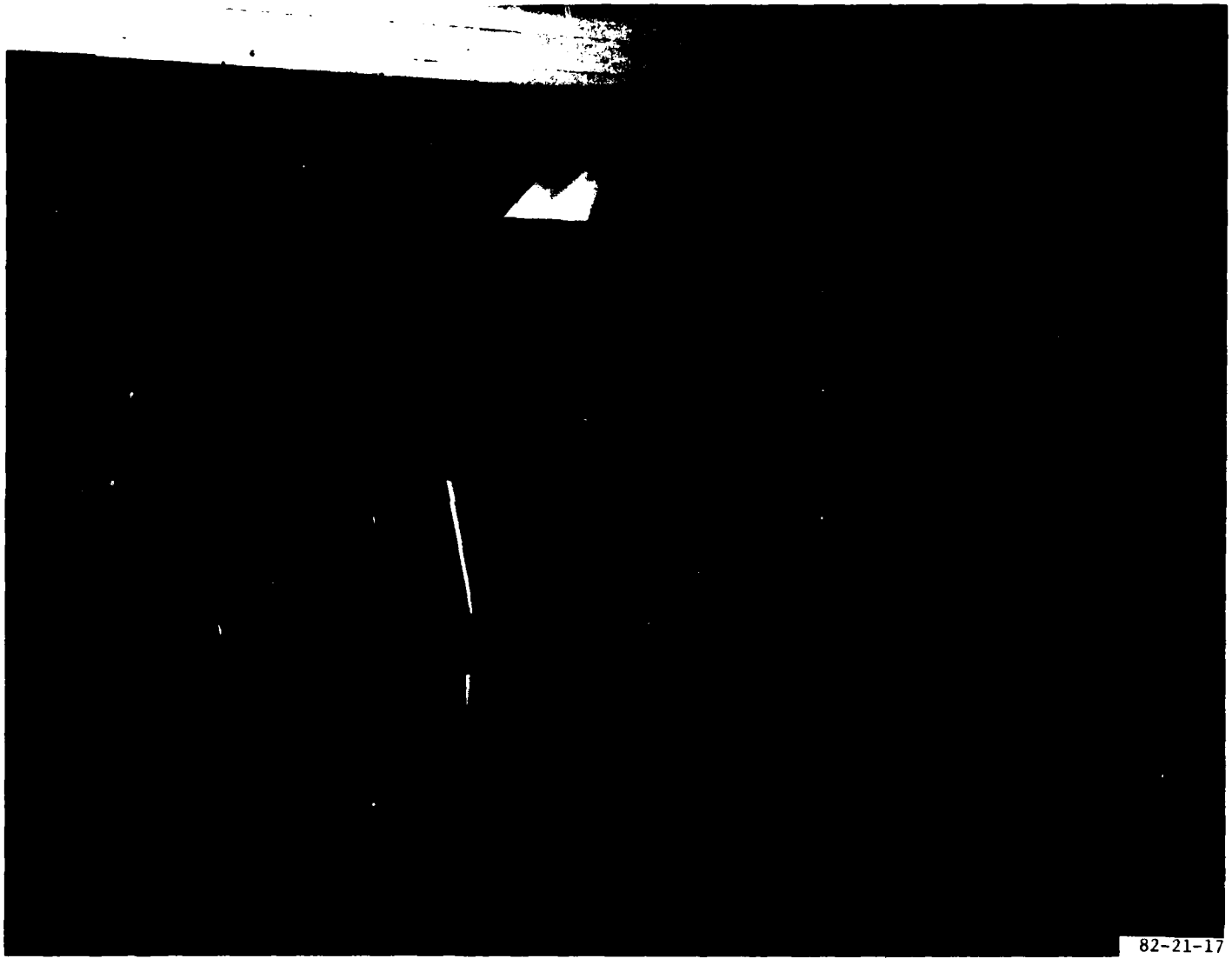


FIGURE 17. WALL WASHING LIGHT — POSITIONED LOW

FIGURE 18. WALL WASHING LIGHT — POSITIONED MEDIUM

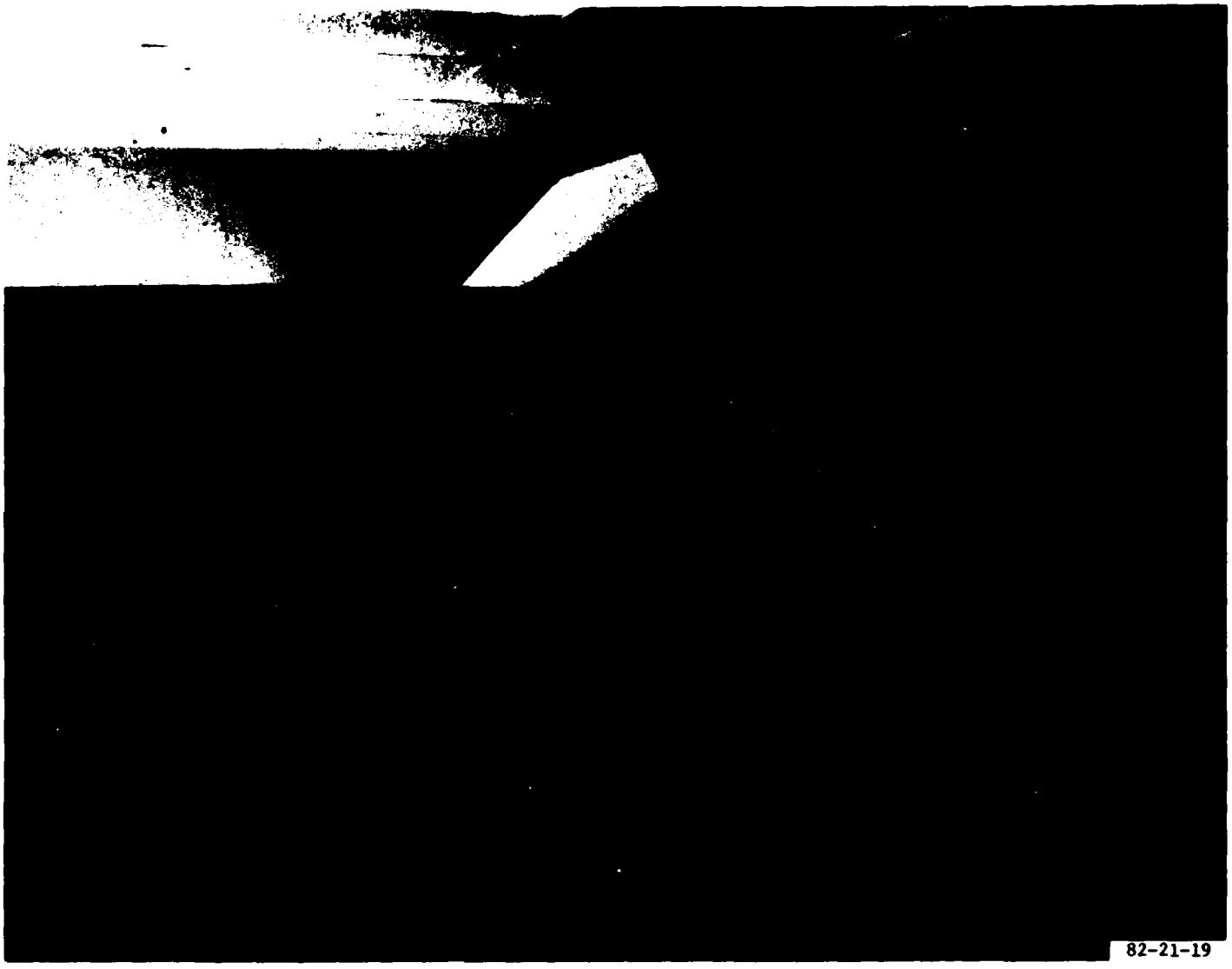
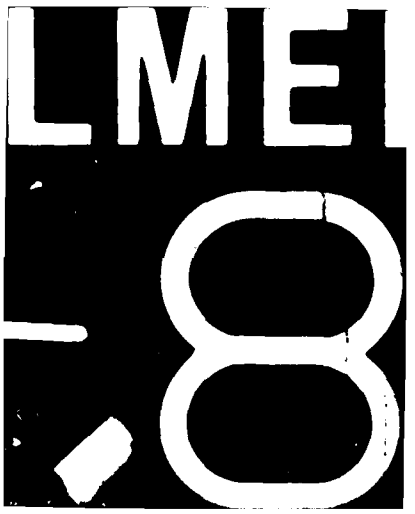


FIGURE 19. WALL WASHING LIGHT — POSITIONED HIGH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